VEGETATION

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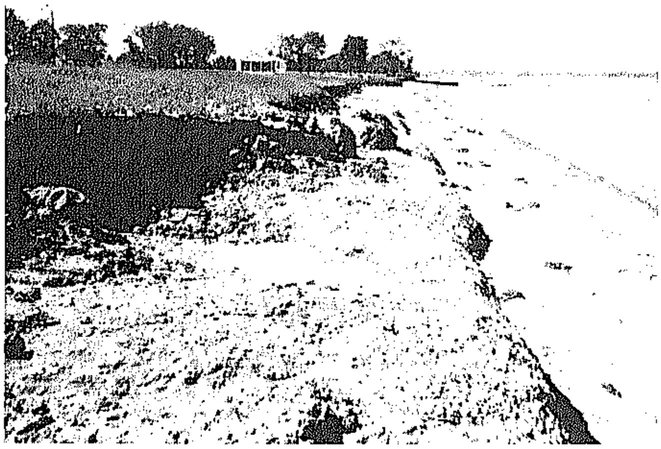
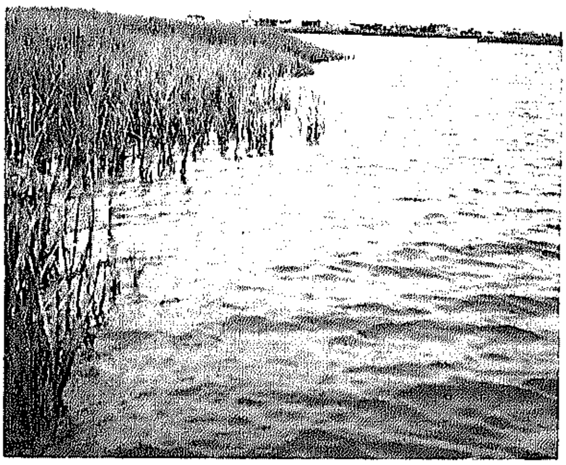


TIDAL SHORELINE STABILIZATION

IN THE



MID - ATLANTIC

STATES

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
BROOMALL, PENNSYLVANIA

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VEGETATION FOR TIDAL STABILIZATION
IN THE MID-ALTANTIC STATES 1/

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INTRODUCTION

Erosion along tidal streams and estuaries in the mid-Atlantic states is extensive. The affected area is shown on Figure 1. In a 1962 study of the Virginia section approximately 23 percent of the shoreline was reported to have experienced some degree of erosion. Approximately 21,000 acres of Virginia shoreline was lost between 1850 and 1950. The study estimates the total volume of material lost by erosion into the Virginia portion of the Chesapeake Bay is 270 million cubic yards.

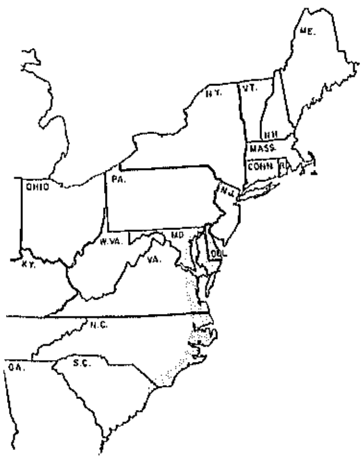

Figure 1 - Area affected by severe tidal erosion in the mid-Atlantic states

1/ This is a summary of published papers, listed on page 18 and experience by the authors.

2/ Plant Materials Specialist, Broomall, Pa., Plant Materials Center Manager, Cape May Courthouse, N.J. and Soil Conservationist, Beltsville, Md., USDA-SCS.

The erosion is the result of storm action, freezing and thawing, and waves eroding the toe of the vertical slope. The slope collapses, soil material is carried away and the process is repeated. See Figure 2. Man's attempt to stop this erosion is normally to build a sandy beach with groins or to protect the slope with a bulkhead, or both. These have worked with a varying degree of success, depending on site conditions and storm frequency and intensity. Both are expensive to install and have undesirable environmental impacts.

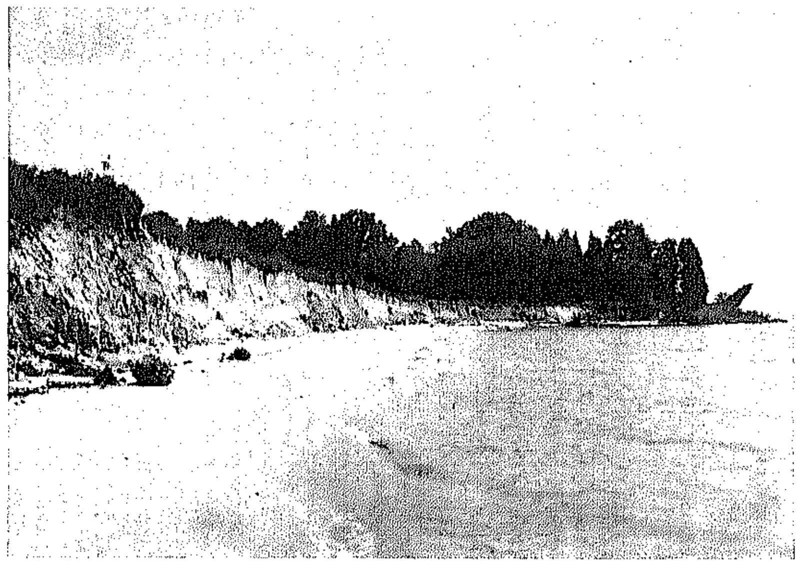

Figure 2 - Typical erosion on tidal streams in the mid-Atlantic area

Many banks are stable or become stable from the natural deposition of material at the toe of the bank followed by the volunteering of adapted vegetation. See Figure 3. Once there, plants provide increased protection against erosion. They may trap littoral drift and sediment, extending the width and raising the elevation of the beach. A combination of the extended beach and the vegetation

absorbs and dissipates wave energy, protecting the bank from erosion. See Figure 4. This natural process can be accelerated by planting adapted vegetation on selected beaches.

Figure 3 - Many banks are stable resulting from volunteer stands of adapted vegetation

The purpose of this paper is to (1) describe procedures for using vegetation along tidal streams and estuaries, (2) how to identify sites where vegetative treatment may be successful, (3) the plants to use for this purpose, (4) how to establish them, (5) how to manage established plantings and (6) how to stabilize sand trapped by groins.

PROCEDURES FOR USING VEGETATION ALONG TIDAL STREAMS AND ESTUARIES

An objective of vegetative beach treatment is to reduce or eliminate the energy of waves striking the eroding bank. Conditions on the

beach of many eroding banks are too harsh for it to become established naturally. The following procedure outlines how to assist nature by planting adapted species above and below mean tide. The basic procedure is shown in Figure 4.

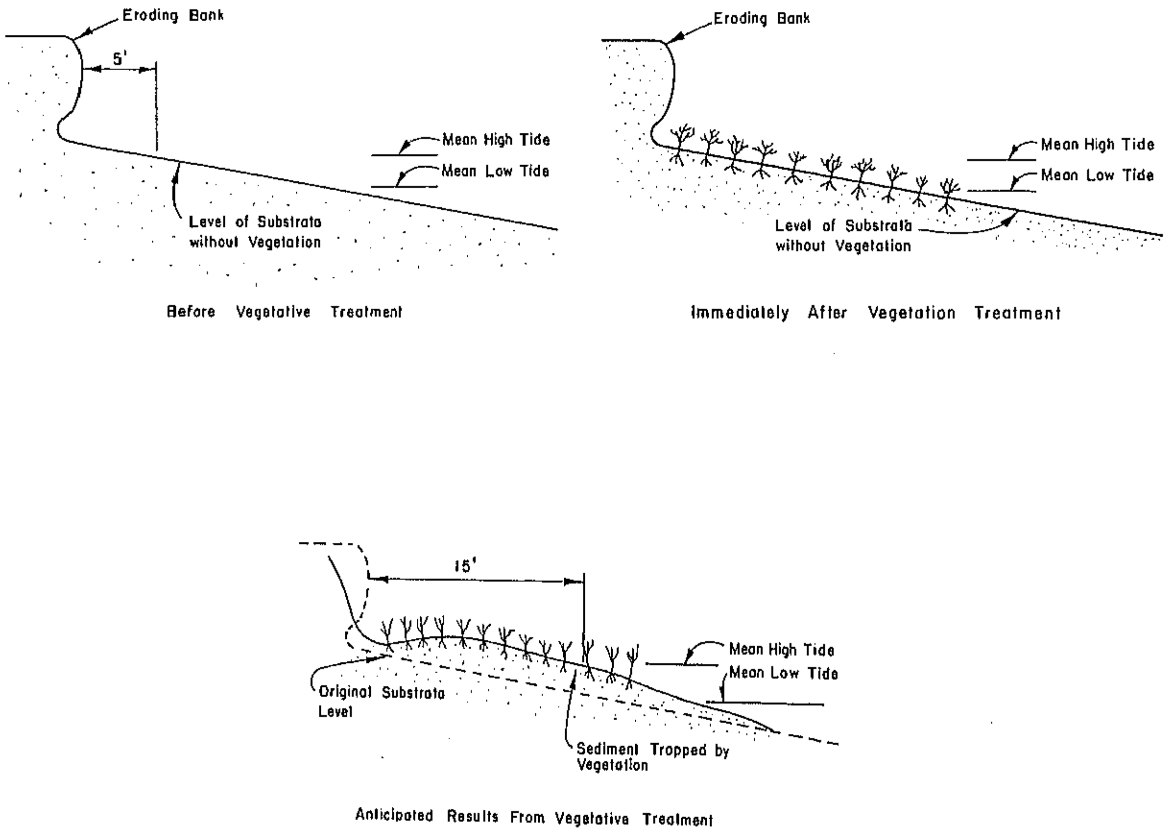

Figure 4 - Potential role of vegetation in tidal shoreline stabilization

Where applicable, this is the most economical procedure to use. The vegetation has the potential of trapping sediment lost from the eroding bank as well as from littoral drift. As this happens, the band of vegetation expands, pushing the mean high tide away from the toe of the bank and provides a dense band of energy absorbing vegetation.

HOW TO IDENTIFY SITES WHERE VEGETATIVE TREATMENTS MIGHT BE USED

A high percentage of plantings made on tidal beaches are subject to failure due to many environmental factors, some of which can be measured. They include offshore gardient, width of beach, fetch, type and depth of beach substrata, presence of beach vegetation, shoreline geometry and shoreline orientation. There are no widely tested guidelines for collectively measuring these factors which would assist in site selection. Tentative guidelines have been developed and are shown in Table 1. They have been checked against a number of planted sites and adjusted to represent actual experience. Their evaluation will continue an additional adjustments may be made.

These guidelines are an attempt to assess how various shoreline variables affect the potential of successfully stabilizing vegetation on eroding tidal shores. Each is assessed independently, with their cumulative effect being used to indicate the potential for stabilizing the site. It can be noted that certain variables have a greater impact on the stabilization potential than others.

Procedure for Measuring Potential Width of Planting Area

Survival of newly established beach vegetation is significantly influenced by the amount of tidal fluctuation. Where the fluctuation is less than 2.5 feet, vegetation can be planted to mean low tide elevation. See Figure 5. Where the fluctuation exceeds 2.5 feet, it should not be planted lower than mean tide. See Figure 6.

TABLE 1 VEGETATIVE TREATMENT POTENTIAL FOR ERODING TIDAL BANKS IN THE MID-ATLANTIC STATES

DIRECTIONS FOR USE

1. Evaluate each of the first four shoreline variables and match the site characteristics of the variable to the appropriate descriptive category.
2. Place the Vegetative Treatment Potential (VTP) assigned for each of the 4 variables in the right hand column.
3. Obtain the Cumulative Vegetative Treatment Potential for variables 1, 2, 3, & 4, by adding the VTP for each.
4. If it is 23 or more, the potential for the site to be stabilized with vegetation is very good and the rest of the table need not be used. If it is below 23, go to step 5.
5. Determine the VTP for shoreline variables 5 through 9 and obtain the cumulative VTP for variables 1-9.
6. Compare the cumulative VTP score with the Vegetative Treatment Potential Scale at the bottom of this page.

SHORELINE VARIABLES	DESCRIPTIVE CATEGORIES The Vegetative Treatment Potential (VTP) Is Located in Upper Left Hand Corner of Each Category Box					VTP for Each Variable
1 Fetch: Average distance in miles of open water measured perpendicular to the shore and 45° either side of perpendicular to shore	8 Less than 0.5 miles	7 0.5 thru 1.4 miles	4 1.5 thru 3.4 miles	2 3.5 thru 4.9 miles	0 over 5 miles see footnote 1/	
2 General shape of shoreline for distance of 200 yards on each side of planting site.	8 Coves	3 Irregular shoreline		0 Headland or straight shoreline		
3 Shoreline Orientation: General geographic direction the shoreline faces	5 Any orientation less than one-half mile fetch.	3 West to North	2 South to West	1 South to East	0 North to East	
4 Boat Traffic: Proximity of site to recreational & commercial boat traffic	5 None	3 1-10 per week within 1/2 mi. of shore	2 More than 10 per week within 1/2 mile of shore	1 1-10 per week within 100 yards of shore	0 More than 10 per week within 100 yds. of shore	

Cumulative Vegetative Treatment Potential for Variables 1, 2, 3, & 4 ________

If this score is 23 or above, the potential for the site is very good and the rest of the table need not be used. If it is below 23, go to step 5 above.

5 Width of Beach Above Mean High Tide in Feet	3 Greater than 10'	2 10' thru 7'	1 6' thru 3'	0 Less than 3'	
6 Potential Width 2/ of Planting Area in Feet	3 More than 20'	2 20' thru 15'	1 14' thru 10'	Less than 10' Do Not Plant	
7 On Shore Gradient % slope from MLW to toe of bank	6 Below 8%	3 8 thru 14%	1 15 thru 20%	0 over 20%	
8 Beach Vegetation	3 Vegetation below toe of slope		0 No vegetation below toe of slope		
9 Depth of Sand 3/ at Mean High Tide in inches	3 More than 10"	2 10" thru 3"	0 Less than 3"		

Cumulative Vegetative Treatment Potential for Variables 1-9 ________

1/ Do not plant or see page 10 and figure 10 for possible exception.

2/ If tidal fluctuation is 2.5 feet or less, measure from MLW to toe of bank. If tidal fluctuation is over 2.5 feet, measure from MW to toe of bank. See page for more information.

3/ Refers to depth of sand deposited by littoral drift over the substrata.

VEGETATIVE TREATMENT POTENTIAL SCALE

If the VTP is between and		Potential of Site to be Stabilized with Vegetation
40	33	Good
32	24	Fair
23	16	Poor
below 16		Do Not Plant

A minimum width of the planting should be 10 feet. If less than 10 feet is available between low tide and the toe of the bank, the site may be unsuitable for planting unless it is in a protected cove. Planting width in excess of 20 feet below mean high tide plus beach vegetation extending from mean high tide to the toe of the slope is usually not justified.

Figures 5 and 6 show the usual planting arrangements. Figure 7 shows a two-month-old planting and Figure 8 shows a 10-year-old

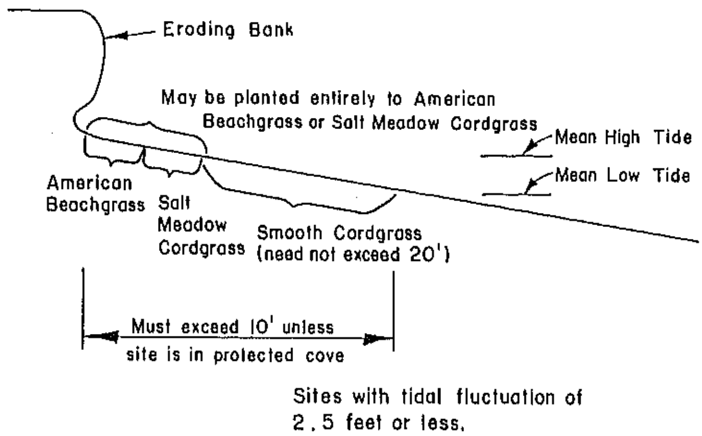

Figure 5 - Recommended planting arrangement when tidal fluctuations is less than 2.5 feet

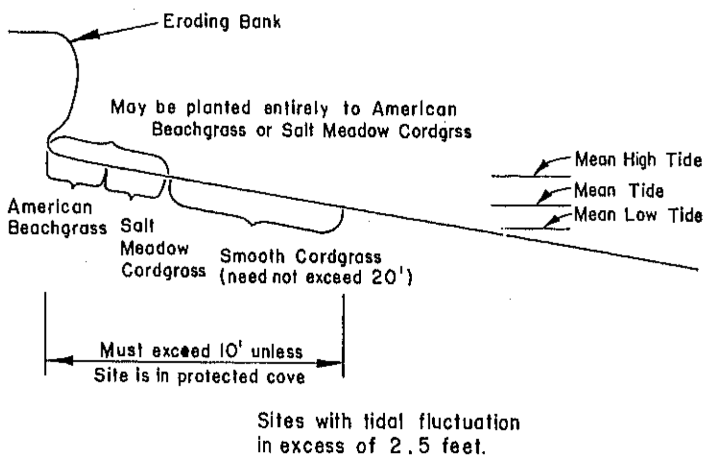

Figure 6 - Recommended planting arrangement when tidal fluctuations exceed 2.5 feet

planting using these arrangements. The American beachgrass or the salt-meadow cordgrass may be eliminated from the planting depending on site conditions. If the beach is narrow, less than 10 feet above mean high tide, and there is less than four inches of sand over the substrata at the toe of the slope, the use of beachgrass may not be justified. The beachgrass will be effective only in sand deposits.

Figure 7 - Two-month-old planting of smooth cordgrass (in front of person) and saltmeadow cordgrass (behind person)

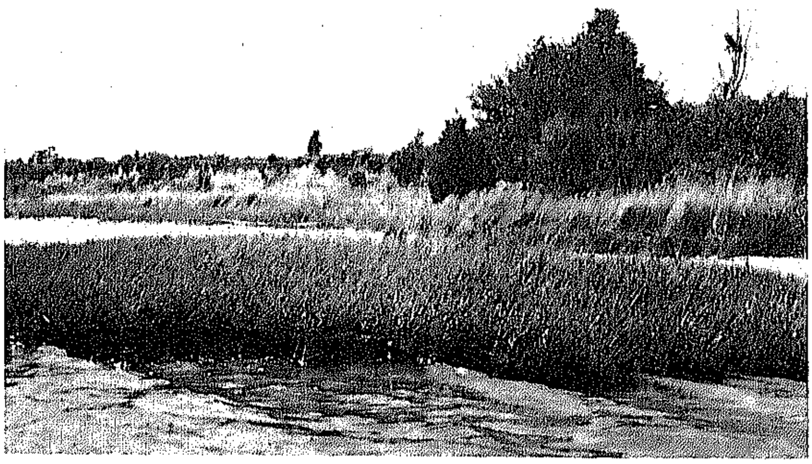

Figure 8 - Ten-year-old planting where smooth cordgrass was planted between mean and mean high water, with saltmeadow cordgrass and American beachgrass planted above mean high water. Note the tree volunteering onto the site. Mean high water is now 50 feet from toe of bank. When planted in 1969 it was at the toe of the bank.

Exception to Fetch Limitation

As shown in Table 1, item 3, sites with a fetch in excess of 5 miles are not recommended for this vegetative treatment. There is another procedure which could be considered. The 5 mile restriction is established primarily for those sites where vegetation is to be planted in the intertidal zone. The potential wave energy of sites with fetch in excess of 5 miles may be so great the vegetation would be destroyed. If such sites still have a vegetative treatment potential score to warrant planting, exclusive of the fetch restriction, and there is evidence of littoral sand drift, a suggested planting procedure is shown in Figure 9. Under certain circumstances, sites with less than 5 miles fetch may also be treated this way. Figure 10 shows two sites where this procedure has been used successfully.

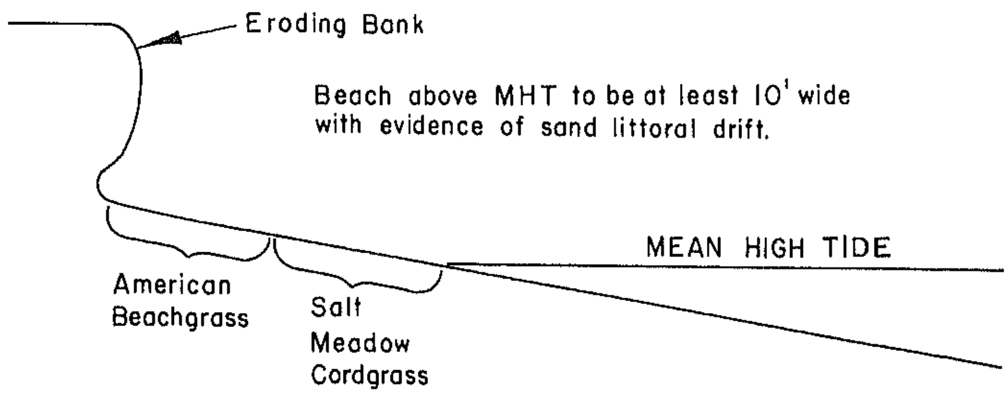

Figure 9 - Planting arrangement when fetch exceeds five miles

Influence of Shade on Site

The effect of shade from overhanging trees on the establishment of beach vegetation must be considered. All sites must receive daily at least 4 hours of direct sunlight throughout the growing season. Trees must be removed if less will be available.

Figure 10 - Examples of successful use of planting arrangements

DESCRIPTION AND ADAPTATION OF SPECIES FOR PLANTING ALONG TIDAL STREAMS AND ESTUARIES

The three species most useful for shoreline stabilization are smooth cordgrass, saltmeadow cordgrass and American beachgrass.

Smooth cordgrass (Spartina alterniflora Loisel.) is the dominant plant in the regularly flooded intertidal zone along the Atlantic and Gulf coasts. See Figure 11. It is the most productive marsh grass. The leaves and stems are smooth throughout except the margins of the blades may be minutely scabrous. It is 1.5 to 8 feet tall with soft and spongy stems often 1/2 inch or more thick. Smooth cordgrass spreads by strong hollow rhizomes. New plants will grow up through deposits of sediment, by rooting at the nodes. Either environmental or genetic factors or a combination of these produce short and tall forms of smooth cordgrass.

Saltmeadow cordgrass (Spartina patens (Ait.) Mchl.) produces extensive slender rhizomes and has an aggressive spreading tendency.

Saltmeadow cordgrass

Smooth cordgrass

American beachgrass

Figure 11 - Principal species used in tidal shoreline stabilization

The stems are small and usually less than 1-1/2 feet tall. The blades are flat and narrow with coarse veins. The flower spikes are 1 to 2 inchles long. Saltmeadow cordgrass, like smooth cordgrass will continue to grow up through new deposits of sediment. See Figure 11.

Both smooth and saltmeadow cordgrass are strong sod formers, but relatively poor seed producers.

American beachgrass (Ammophila breviligulata Fern.) is a leafy, rapidly spreading grass. It may reach a height of two to three feet. The seed head is a spike-like panicle, about 10 inches long, and appears in late July or August. Leaves are long, coarse and narrow, and may become rolled or folded as they mature.

American beachgrass produces rapid-growing rhizomes that spread beneath the sand and give rise to many new plants. Its vigorous growth enables the plant to withstand deep deposits of sand and grow up through it. See Figure 11.

The natural area of adaptation of smooth cordgrass is the zone between high and low tides along brackish streams. Saltmeadow cordgrass is usually found between mean high tide and the area above any tidal influence. Both cordgrasses tolerate a wide range of salinity and substrata textures, from coarse sands to silty-clay sediments. Both are well adapted to the anaerobic substrates characteristic of most salt marshes. Smooth cordgrass requires a semi-inundated environment, while saltmeadow grows well in completely aerobic conditions. Both are found growing naturally along the Atlantic coast from Newfoundland to Florida.

American beachgrass is native to the mid-Atlantic coastal sand dunes from Maine to North Carolina, and the Great Lakes region. It prefers deep sands and grows best where it receives deposits of wind-blown sand. It will grown on inland sites high in sand and/or saline content, provided a maintenance fertilization program is followed.

The geographic areas of adaptation of each grass is shown in Figure 12.

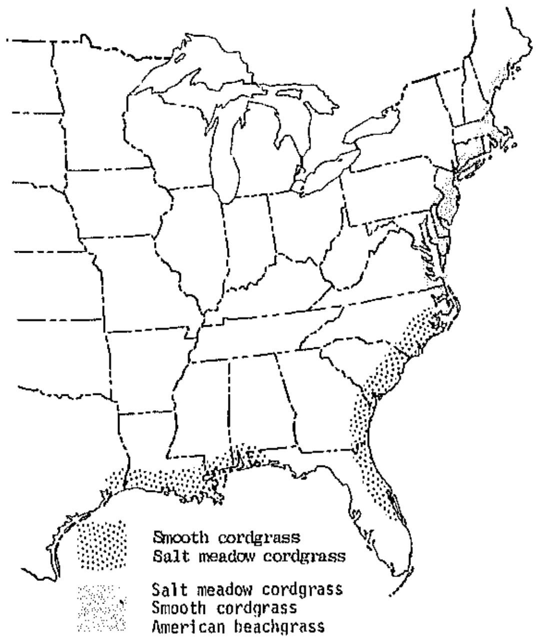

Figure 12 - Area of adaptation of principal species used for tidal shoreline stabilization

PRODUCTION AND ESTABLISHMENT OF ADAPTED SPECIES

There are two appropriate ways to produce smooth cordgrass plants for use on tidal beaches. One is to grow seedlings in containers such as peat pots for a few months until they are large enough for transplanting. The plants will be about 12 inches tall when the root system is well developed. Each pot should contain 3-5 well-developed culms. Bare rooted plants can also be obtained from natural stands or from plants grown in intertidal or artificially flooded nurseries. Natural stands from which plants are taken should be open and growing in sandy substrata and from developing rather than established stands. Plants dug from clay or organic substrata have not proven satisfactory and are difficult to dig. Potted plants will usually produce the most rapid developing stand. Unless strong vigorous growing culms can be dug from natural stands, which are frequently difficult to find, the use of potted plants are recommended.

Saltmeadow cordgrass can be field grown and the slender culms dug and processed for transplanting. Plants of saltmeadow cordgrass can also be produced in peat pots, which is highly satisfactory. Their use versus field grown plants is recommended because of the more rapid growth they make on tidal beaches. Plants of saltmeadow cordgrass dug from natural stands are usually unsatisfactory.

While American beachgrass could be grown in peat pots or other containers, it is normally field grown by commercial nurseries and the culms dug and transplanted bare root. Field grown culms perform very well when transplanted.

Plant materials of all three grasses are available commercially. There are no improved varieties of the cordgrasses. 'Cape' American beachgrass is recommended. Types of planting stock is shown in Figure 13. While there is a definite cost advantage to using field grown, bare-rooted stock of the cordgrasses, container grown plants

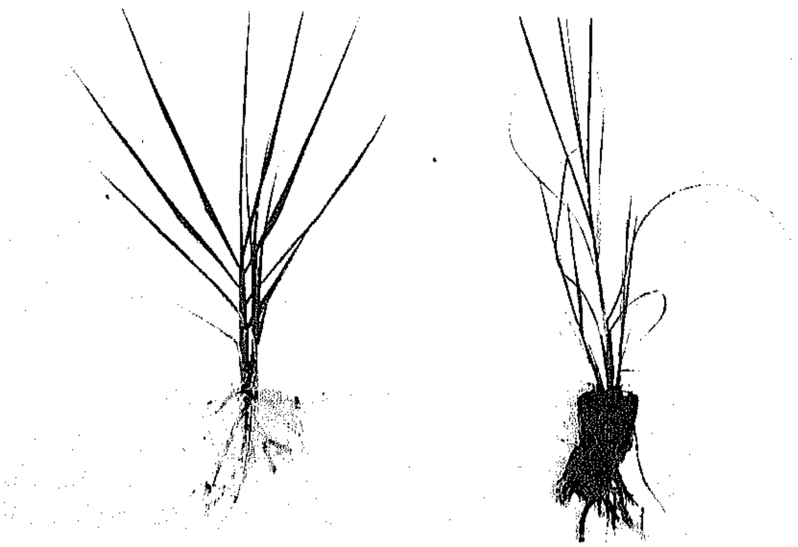

Figure 13 - Field grown (left) and potted (right) planting stock of smooth cordgrass

increase the chances of a successful establishment, particularly on the most difficult sites.

When planting on tidal beaches with field grown material, use three to five culms of saltmeadow cordgrass and beachgrass and two culms of smooth cordgrass in each hill. Plant the culms to the same depth they were growing when dug. When container grown seedlings of the cordgrasses are used, plant one container per hill. The hills should be 12-18 inches apart within a row and the rows parallel to the shoreline, 2 to 3 feet apart, depending on the severity of the site being stabilized. The less erodible sites may be planted in the wider spacings.

Whether using culms or container grown plants, the hole in the substrata should be opened enough to accommodate the roots or container, then sealed by pressing the soil around the roots.

Some plant nutrients must be applied at the time of planting. A slow release fertilizer, such as Mag Amp or Osmocote is preferred, although formulations of chemical fertilizer such as 10-10-10 have shown response. About 1 to 2 ounces of fertilizer should be placed in a hole to the side (side dressed) of the plant. Broadcast application may be washed away by the tide.

If container grown plants are used, the time of planting can be extended from early spring to July 1. Very early spring plantings

are more hazardous than late spring plantings because of the increased risk of storms. This, plus more favorable soil temperatures for plant growth, favor mid or late spring plantings.

If field grown bareroot plants of American beachgrass and saltmeadow cordgrass are used, they must be planted by April 15. They can be dug in March or early April and held in cold storage. The beachgrass can be stored for a period not to exceed 60 days, but the cordgrass should not be stored for more than 30 days. The desirability of late spring plantings and problems with storage of bareroot plants tend to favor the use of container grown stock.

MANAGEMENT OF ESTABLISHED PLANTINGS

All plantings should be monitored frequently. If a portion of planting is destroyed or fails to establish it should be repaired by replanting as soon as possible. Fertilization following the year of establishment is recommended if plant development is inferior to natural marshes in the adjacent area. Use 300-500 pounds per acre of 5-10-10 or 10-10-10 over the vegetated area at ebb tide. Apply in late May or June. If debris is washed onto the planting, it should be removed immediately or it may smother the plants.

HOW TO STABILIZE SAND TRAPPED BY GROINS

Groins that function properly rapidly fill with sand. The elevation of the sand will be no higher than the top of the groins

and is subject to being removed by storm tides. American beachgrass planted on the trapped sand when the groins are nearly full will help hold what is there and trap additional sand. If adequate sand is available from littoral drift, the combination of the two can materially increase shoreline protection over the groins used alone. See Figure 14.

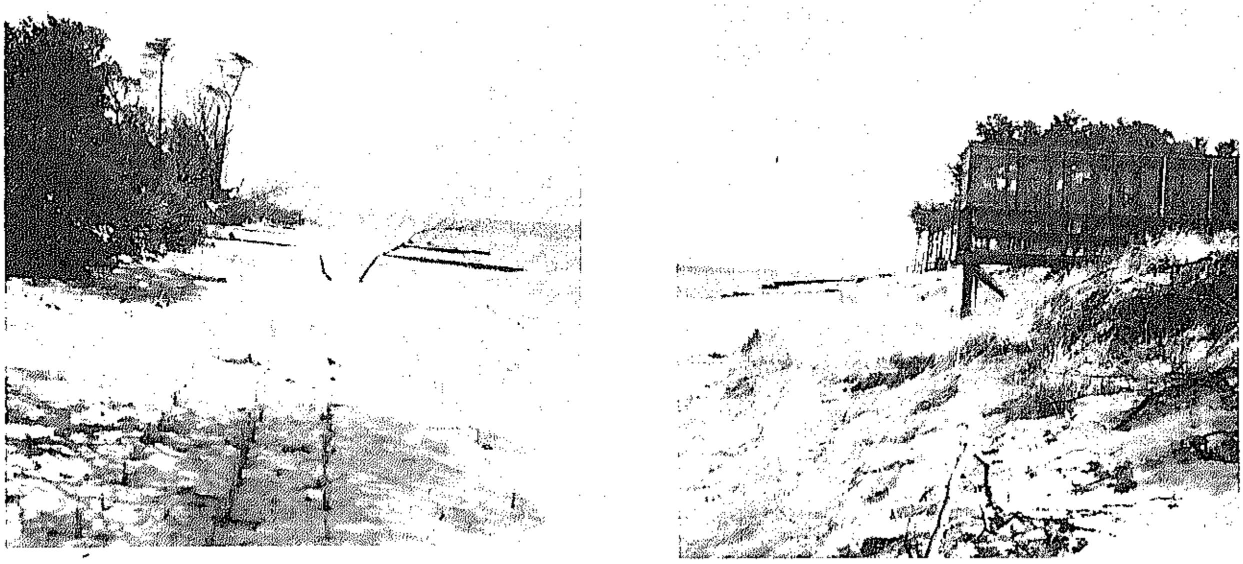

Figure 14 - On the left are groins filled with sand that have been recently planted to American beachgrass. On the right are groins and American beachgrass combined to accumulate sand and tie it into the bank. Note the tips of the jetties sticking out of the water

Procedures discussed earlier for establishing the beachgrass should be followed. Plant to within about 15 feet of normal high tide.

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